→ Proteins derived from protos → first / prime (basic role in cells) → functionally imp

Day: Def: polymers of amino acids (more than 10 AA) Date: / /

- Most abundant organic compounds → proteins
- most abundant organic component → water.
- 50% of the total dry mass
- C, H, O, N → essential elements (present in all)
- Sulphur → non-essential.

→ Classification based upon R-group ← characteristic properties ← reacting groups ← variable group ← variety

(1) Non polar aliphatic R-group

Glycene, alinine, isoleucine, valine, leucine, methionine

(2) Polar unbranched

Serine, cystiene, glutomine, threonine, proline, asparagine

(3) Positively charged

lycine, arginine, histadine

(4) negatively charged

aspartate, glutomate

(5) non-polar aromatic

phenyl alanine, tryptosine, tyrosine, tryptophan

→ amino & carboxylic group → reacting group

→ smallest amino acid → (having H-atom as R-group)

Ans) Glycine

→ R group ——— replaced by CH_3 → Alonine

→ S → (1) cystiene (2) methionine

→ formation of disulphide bridges → cystiene

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Day: Date: / /

Feature	Acylglycerols	phospholipids	Waxes	Terpenoids
Composition	• glycerol • fatty acids	• Glycerol • fatty acids • phosphoric acid • Nitrogenous base	• Alkanes • Alcohols • ketones • Esters (of long fatty acids)	• Isoprenoid units (X do not contain fatty acids)
	• triglyceride neutral lipid	• phosphatidylcholine (lecithin)	• Cutin (cutan, cuticle)	• Rubber • terpenes • caretenoids
ROLE	• energy reserve	• membranes	• protection	• photo synthesis

- polymeric forms → terpenoids
- commonly associated with membranes → phospolipids
-

Acyl glycerols:- (even number of carbon atoms)

esters of alcohol + F.A

$$R\text{-}OH + HO\text{-}C(=O)\text{-}R \xrightarrow{\text{condensation}} R\text{-}O\text{-}C(=O)\text{-}R + H_2O$$

Alcohol (base → OH) — fatty acid (acid → H) — Ester.

$$H_2C(OH)\text{-}CH(OH)\text{-}CH_2(OH) + 3\,HO\text{-}C(=O)\text{-}R_1R_2R_3 \rightarrow CH_2(O\text{-}C(=O)\text{-}R_1)\text{-}CH(O\text{-}C(=O)\text{-}R_2)\text{-}CH_2(O\text{-}C(=O)\text{-}R_3) + 3H_2O$$

type of alcohol (glycerol)

Acyl glycerol (Triglycerides)

Neutral lipids (bc₂ pH = neutral)

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Acylglycerol → most abundant lipid.

Day: Date: / /

fats	oils
• solids at room Temp (25°C)	• liquid at room T (25°C)
• Fatty acids ① saturated -C-C-C-C- → In animals	Fatty acids ② unsaturated. C=C-C=C (1-6 double bonds) → more = bonds more lipid state → ... → further elements can be added → In plants

Effects

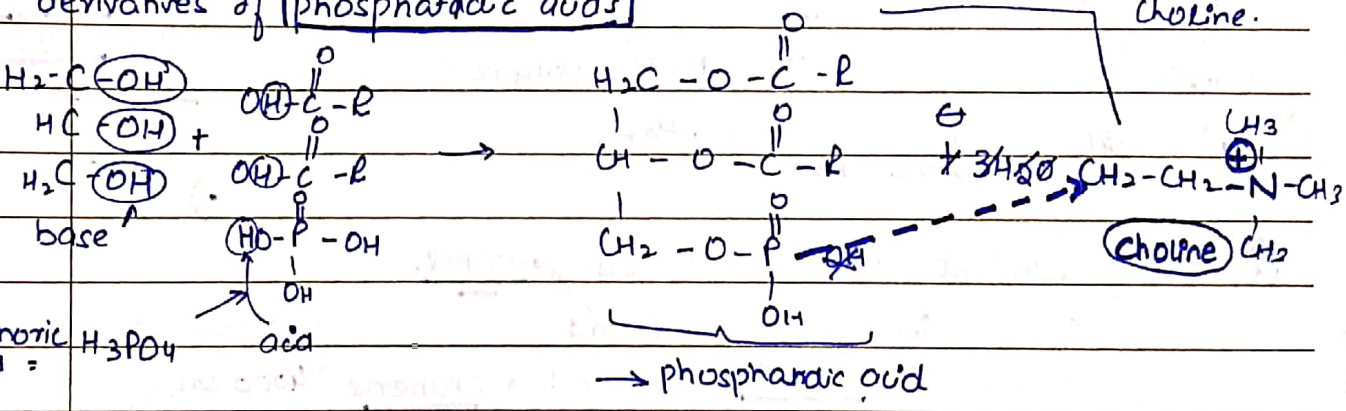
①	low solubility ↓	more solubility ↑
②	M.P (low)	High M.P
⚠	C_4 (butyric acid) خطرناک	Palmaric acid (C_{16})

→ Phosphoplipids:-

(most abundant phospho lipid)

def:- derivatives of phosphatidic acids

→ phosphatidyl choline.



Uses

- Cell membranes (phospholipids (schwann cells) → form myelin sheath).

•) WAXES → mixtures (so has no def formula)

•) long chain alkones	•) alcohols	ethers	esters of fatty acids & glycerol
•) C-25 → C-35			
•) odd numbers			

uses ① bifacial leaves shine due to wax

② fruit peels or seeds shine (e.g leechee)

③ Bees (insulating layer) have

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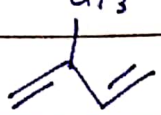
Day: → Terpenoids (only group of lipids in polymer form)



(When these units condense in diff ways results in diff structures terpenoids)

Date:

Def → derivatives of isoprenoid units (monomers)

e.g. carotenoids (in plants)

* Steroid (work more speedily than enzymes
  ↳ also are harmful

* cholestrol → base of sex hormones (during period of development it makes boys or girls).
  ↓
  can cause narrowing of arteries.

Introduction to Biological Molecules

polymer → made up of (simple repeating unit) → monomer (micro molecules)
↳ macromolecule

→ Monomers (sugar (pentose)) Polymer

1. monosaccharides → polysaccharide (sugars)
2. organic bases → nitrogenous bases. (A, G, T, C) → nucleotide → monomer → nucleic acids → polymer
3. Amino acids → polymerization → protien.

Lipids → non polymer
these are macro molecules but not polymers and fatty acids cannot be considered as monomers except

Q) Most abundant component of cell → water.
" inorganic compound
" organic compound → proteins (1 gram 4000 cal/g)

Q) primary products of photosynthesis → Carbohydrates (1 gram produces 3800 cal/g)

Q) primary fuel for respiration → Carbohydrates → lipids → proteins
first preference. ↳ If deficient

Q) High energy respiratory substrates → lipids (9000 cal/g) → double than that of carbs or proteins

Q) defined on the base of physical properties → lipids
bcz solubility → physical property.

Q) All are usually polymers except → lipids

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• proteins • lipids
• nucleic acids > all are derived from carbohydrates.

Day: C, H, O → essential elements of all organic biomolecules. Date: / /

(S) → only present in proteins (P) → in nucleic acids, lipids

(N) → proteins, lipids, nucleic acids

(N) is essential elements of → proteins, nucleic acids

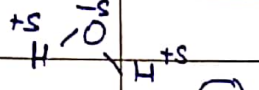
WATER → Inorganic (Mineral) bilogical molecule

•) most abundant component (of cell, body, fluid, blood, cytoplasm etc)

•) medium (cradle) of life. (all reactions in the body take place in aqeous medium)

• 65 - 89 % in living organisms ↗ bone cells 20%.
↘ brain cells 85%.

① Polar Nature



• H-bond by (+S) of H & (-S) on O

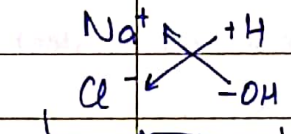
•) Non-polar substances
→ insoluble
• is imp to keep some structures intact
• like if plasma membrane components were soluble in water it would get dissolved.
• skin is insoluble
• our body structures consists of those substances which are insoluble in water.

② Solvent properties

• universal solvent

• polar substance
"like dissolves like"
↳ in water soluble by H-bond

• Ionic substances
In water ionize

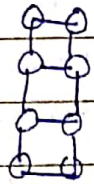


↳ Hydration
↳ dissolve by ions

• solubility of polar solvents is imp bcz carbs, ions require to dissolve in water for their function

③ Cohesive & Adhesive forces

→ Cohesion
• attraction b/w water molecules
↳ due to H-bond.
• due to cohesion, water flow without break.



→ Adhesion
• attraction b/w H_2O & surface
• helps in climbing up the vessel

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④ Specific Heat Capacity:- no of cals required to raise the temp of 1 g of H_2O through 1°C (15 → 16°C)

Day: Value (1 calorie/gram) = 4.2 Joule/mole Date: / / H-bond.

→ high specific heat capacity as compared to other compounds due to

→ Significance

Temperature stabilized (protection from thermal changes)

⑤ Heat of Vaporization:- amount of heat required to vaporize (convert from water → gas) the water. Temp = 100°C. (B.P)

- per gram Value = (574 kcal/kg) or cal/g (high than other compounds due to H-bonding)
- Imp
  - cooling effect (sweating, transpiration) → bcz water takes away heat.
  - 1000 ml / 2 ml → vaporized
    30° → 998 ml, 29°C ↓ 1°C.

⑥ Expansion & surface Tension →

- When T = 4°C
- ↓ converts to ice
- less dense ↓ d = m/v (v ↑ expand)
- floats on water
- prevents water from freezing in northern areas
- provides insulation to organisms in cold areas

→ High surface tension
→ thin film on the membranes which keeps it moist
e.g in alveoli for transport of gases

⑦ Ionization → ionize to H+ / OH-

$H_2O \rightleftharpoons H^+ + OH^-$

- Ionization constant → extent to which it can ionize

10^{-7} moles/litre for (H^+ & OH^-)

$H_2O = 10^{-14}$ moles/litre

E.g in photosynthesis (Photolysis of H_2O)

$H_2O \rightarrow H^+ + OH^- \rightarrow NADPH$

$\rightarrow O_2$ → in atmosphere

⑧ Protection

- Lubricant → protection from friction (acts as)
  e.g Synovial fluid (protects end of the bones from friction)
  → pleural fluid → around lungs to protect expansion during expansion & contraction
  → pericardial fluid → around heart
- Cushion → protection from trauma
  - CSF (cerebrospinal fluid)
- nerve brad disc.

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MCQs ① Water acts as universal solvent due to its polar nature

Day: Condensation $O^{\rightarrow H} + O^{\rightarrow OH} \rightarrow OOH + H_2O$ (or without release of H_2O) due to valency forms bonds Date: / /

small compounds

→ if H_2O is released then is called (dehydration synthesis)

→ polymers are formed by condensation reactions by monomers.

e.g amino acids are formed by C.R

Hydrolysis $OO + H_2O \rightarrow O-H + O-OH$ eg breakdown of proteins to amino acids by hydrolysis

water breakdown

Lipid $\xrightarrow{+H_2O}$ fatty acids + glycerol (Hydrolysis)

→ Responsible enzymes → Hydrolases

Hydrolyase:
- Amylase → ⊘ hydrolysis of polysaccharides
- pepsin → " of proteins

Condensation

CARBOHYDRATES → hydrates of carbon $C + H_2O$ (2:1)

e.g $C_5H_{10}O_4$ (2:1 − X) exception of ratio.

→ $C_x(H_2O)_y$ → general formula

x & y can be same or diff

same → mono, diff → oligo/poly

$C_{(6)}(H_2O)_{(6)}$ $C_{(12)}(H_2O)_{(11)}$

Correct Def:

(polyhydroxy derivatives of aldehydes & ketones)

- multiple OH groups present on all carbons except 1 carbon of aldehyde or ketone)

→ Ribose sugar → aldo sugar (C_1)

has 5 of C-atoms but 4-OH)

→ primary products of photosynthesis

→ also give rise to conjugated molecules

-) Glycolipids) glycoproteins

↳ associated with cell surface.

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Day: Date: / /

Feature	Mono	Oligo (few)	Poly
• Common name	Simple / single sugars	Complex sugars	highly complex sugars
• Solubility in water	easily soluble	less soluble	sparingly soluble (under certain conditions.)
• Hydrolysis	Cannot be hydrolyzed	cannot be	→ can be hydro
• Taste	Sweet	less sweet	tasteless
• Formula	$(CH_2O)_n$	$C_n(H_2O)_{n-1}$	$C_n(H_2O)_y$
• Classification	• Type of functional group (e.g. aldo sugar, keto sugar) • Number of C atoms (3-7)	Number of mono-saccharides released on hydrolysis	→ Role • functional • structural — Polymerization • homopolymer • copolymer

Q) X and Y is same in the general formula of → monosaccharides

Q) soluble in water and can also be hydrolysed → Oligosaccharides

→ **Monosaccharides**

Classify → on the base of functional groups
→ Number of C-atoms (3-7)

• smallest sugar in nature → triose

→ structural isomers

Form	molecular formula	Aldo	Keto	Role
Trioses (3C)	$C_3H_6O_3$	Glyceral-dehyde	Dihydroxy acetone	Intermediate in photosynthesis & respiration
Tetroses (4C)	$C_4H_8O_4$	Erythrose (A) x100%	Erythrulose (K)	photosynthesis in bacteria
• most common monosacch in nature		rare in nature		
Pentoses (5C)	$C_5H_{10}O_5$	Ribose (in RNA)	Ribulose	DNA, RNA photosynthesis
Hexoses (6C)	$C_6H_{12}O_6$	Galactose, Glucose	Fructose	• energy source • monomers
Heptoses (7C)	$C_7H_{14}O_7$	Glucoheptose	Sedoheptulose	Photo synthesis
5 rare				

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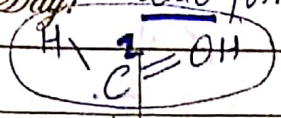
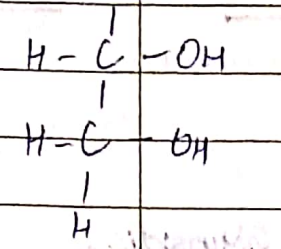
Day: Date: / /

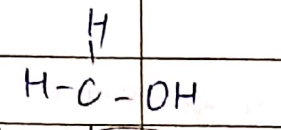
Triose

aldo form

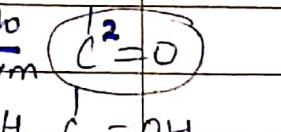




• Glyceraldehyde



keto form

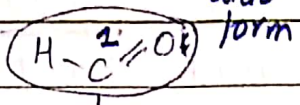


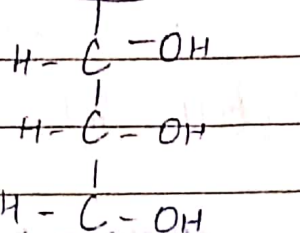
• Dihydroxy acetone

(• OH group is present on all C-atoms except functional groups)

Pentose

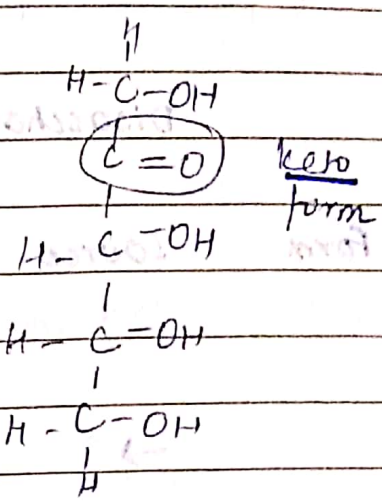
aldo form





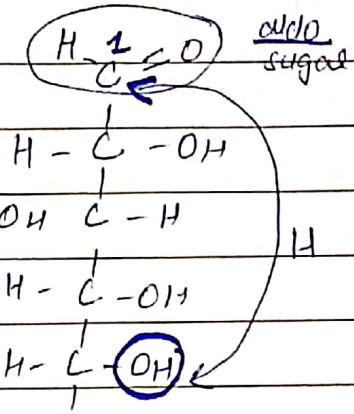
• Ribose

• Riboketose



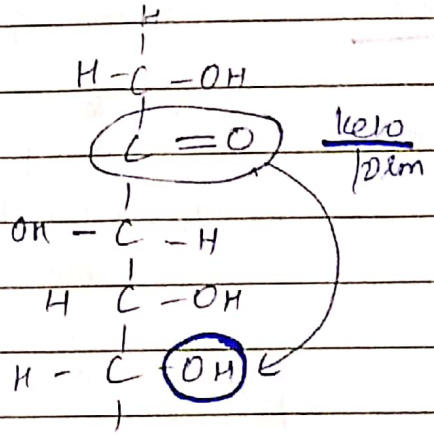
keto form

→ Hexose



aldo sugar

• Glucose

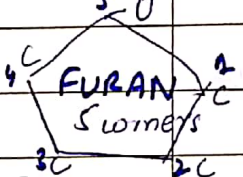


keto form

• Fructose

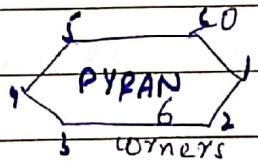
In dry form pentoses & hexoses → straight chain

In ring form → waves → forms ring



Furanose

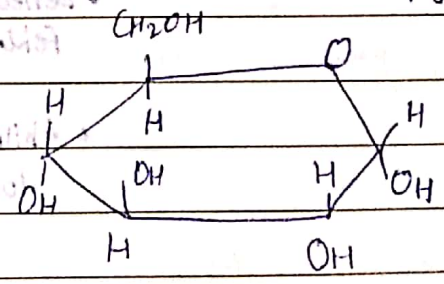
• heterocyclic → diff elements at corners.



Pyranose

• heterocyclic

• Glucopyranose



(ring is formed b/w C of F.G and second last C)

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Oligosaccharides (2 - 10 simple units)

Day: Tew Date: / /

Classified on the base of hydrolysis

if upon hydrolysis they yield 2 units → disaccharides (most common oligosaccharide)

3 units → trisaccharides

Disaccharides ($C_{12}H_{22}O_{11}$)

(carbo hydrates branced (α 1,6 related to (b/w Caloms

Form	source	component	Glycosidic linkage
Maltose	fruits/malt sugar	α glucose (C-1) + α glucose (C-4)	α-1,4

$C_1 - O - C_4$ ← representation

→ Glucose + Glucose ⇌ (maltase / condensation) Maltose + H_2O (hydrolysis)

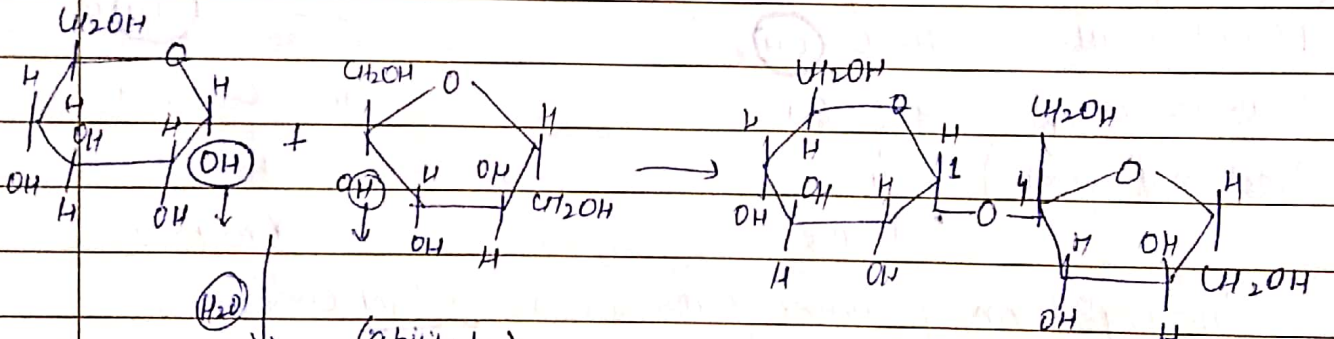
(most common di-sugar)

Sucrose — Sugar cane (cane sugar — α glucose 1 + β fructose 2 — α-1,2

Lactose — → milk / milk sugar — β galactose (1) + β glucose (4) — β 1,4

→ Glucose + Fructose → Sucrose + water

→ Glucose + Galactose → lactose + water.



Reducing Sugars (ability to donate $\bar{e}$)

→ can cause reduction

(solution of the colour changed) positive result ← • Benedict / Fehling test → Negative result

Yes — • Ability to donate $\bar{e}$ — No

All monosaccharides + Maltose + Lactose + Glucose

• Examples imp

All polysaccharides + Sucrose + Starch.

Non-reducing sugar

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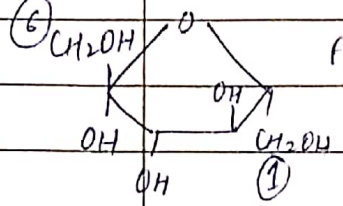
In lactose glycosidic linkage is formed b/w
C_1 of galactose + C_4 of glucose

Day: → mono

Date: / /

In glucose structures how many C-atoms are out of the ring → (1) C_6



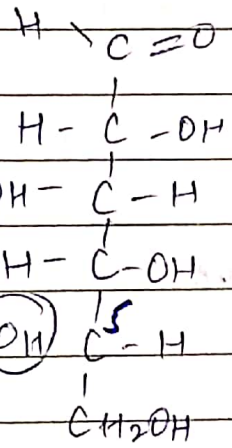
fructose has 2C (C_1 & C_6) out of the ring

Folded structure
• Fructofuranose

→ most common hexose
• glucose
→ most common carbohydrate
• cellulose

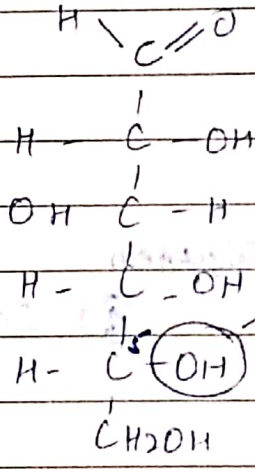
Stereoisomers → some molecular formula, some structural formula, at some level orientation of atoms will be changed (optical isomers)

- Mirror images of one another
- D & L forms are formed on the basis of C5 → farthest C from aldehyde group



L configuration

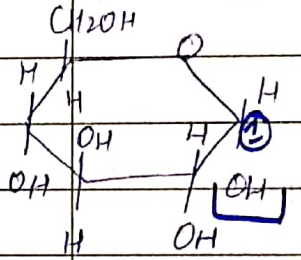
formed synthetically → **L Glucose**



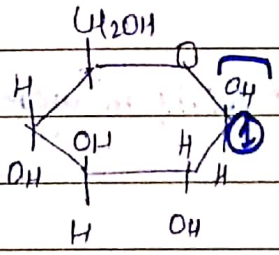
(In open chain C5 is the basic)

right side → D configuration

D-Glucose → naturally exist



α-glucose



β glucose

in rings on the base of C_1

mcqs

1) aldopentose → ribose
2) most common mono saccharide
   • Hexoses
3) Ring formation is the character of • pentoses, hexose
4) Ophical isomers mirrors
   • D & L glucose

•) Deoxyribose is a derivate of ribose

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Polysaccharide (polymers) High complex sugars → not rarely bcz are not sweet

Date: / /

Classifications → structural
→ functional (base of role)

• Structural

(1) homopolymer → made of same repeating units
e.g cellulose ← β glucose (monomer) ← α glucose ← starch (polymer)

(2) heteropolymer → made of diff units
e.g hemi
heterocellulose → polymer of pentoses & hexoses

→ heterosaccharide → modified carbohydrate (containing any element except C, H, O)
e.g chitin → N containing poly saccharide
→ homopolymer

• Functional

(1) Storage e.g starch, glycogen.
(2) Structural → cellulose, chitin

- In our body α-amylase helps to digest carbs (break α glycosidic linkage)
- Cellulase has β glycosidic linkage
So α amylase cannot break it
protozoans, fungi, bacteria → cellulase

	Starch	Glycogen (Animal Starch)	Cellulose	Chitin
(1) Organisms	plants, green algea	animals, fungi per prokaryotes	cell wall of plants, algea, fungi like protists	fungi (cell wall), exoskeleton of arthropods
(2) location	fruits, grains, seeds, tubers	liver, muscles	cell wall	cell wall
(3) Hydrolysis product	α-glucose	α-glucose	β glucose	N-acetyl β glucosamine
(4) Solubility in water	→ Amylose / amylopectin (soluble) (insoluble) under heat conditions) → Light	insoluble	→ highly insoluble	insoluble
(5) branching nature (α 1-6 linkage)	amylose (unbranched)	→ highly branched	unbranched	unbranched
	amylopectin (branched)			
	→ amylose (α 1,4)	(1) linkage	β 1,4	//
	amylopectin (1,4, 1,6 at branch)	α-1,4 + α-1,6		β-1,4

Yousaf

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Iodine test (grams iodine solution)

→ Starch — positive — blue or blue black

~~Glycogen~~ — +ve — red or brick red

Cellulose — Chitin — no change

Day: Date: / /

MCQs

Heteropolymer → Hemicellulose (pentoses & hexoses)

most abundant polysaccharide in nature → cellulose

both α-1,4 , α-1,-6 glycosidic linkage → amylopectin

yields β-glucose on hydrolysis → cellulose

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